

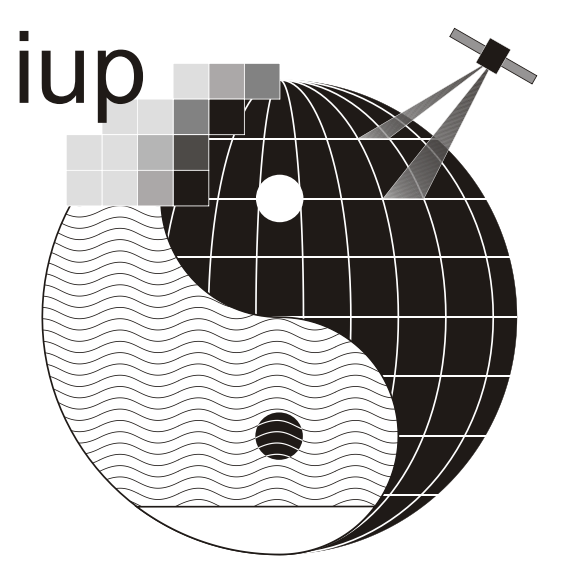
Interpretation of stratospheric NO₃ number density profiles retrieved from SCIAMACHY lunar occultation measurements using retrieved ozone and NO₂ profiles

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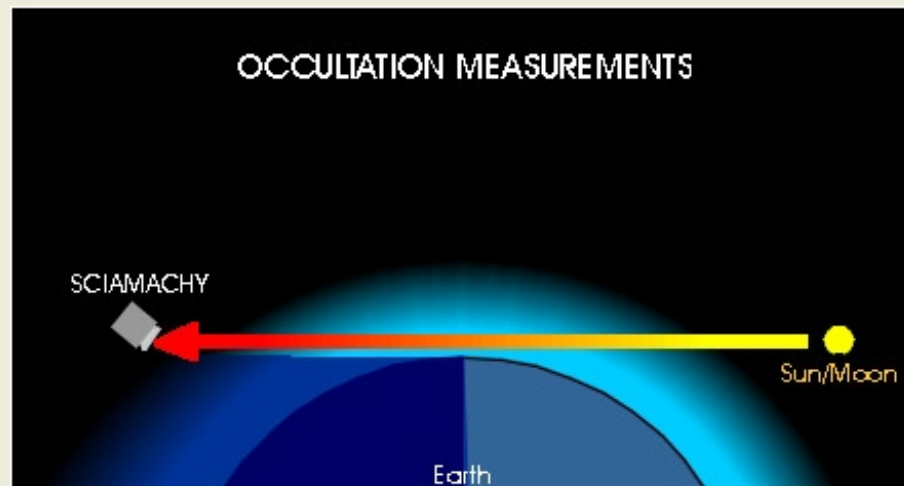
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Introduction

Stratospheric number density profiles of NO₃ were retrieved from moderately resolution lunar occultation transmission spectra measured by Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) on board the European Environmental Satellite (ENVISAT). The measurements were taken over the high southern latitudes (60° S - 90° S). The global spectra fitting method by differential optical depth approach was applied to fit NO₃ using the visible spectral range of 615 - 680 nm containing NO₃ intense absorption bands near 623 and 662 nm. Thereafter the optimal estimation method was applied to retrieved NO₃ vertical profiles.



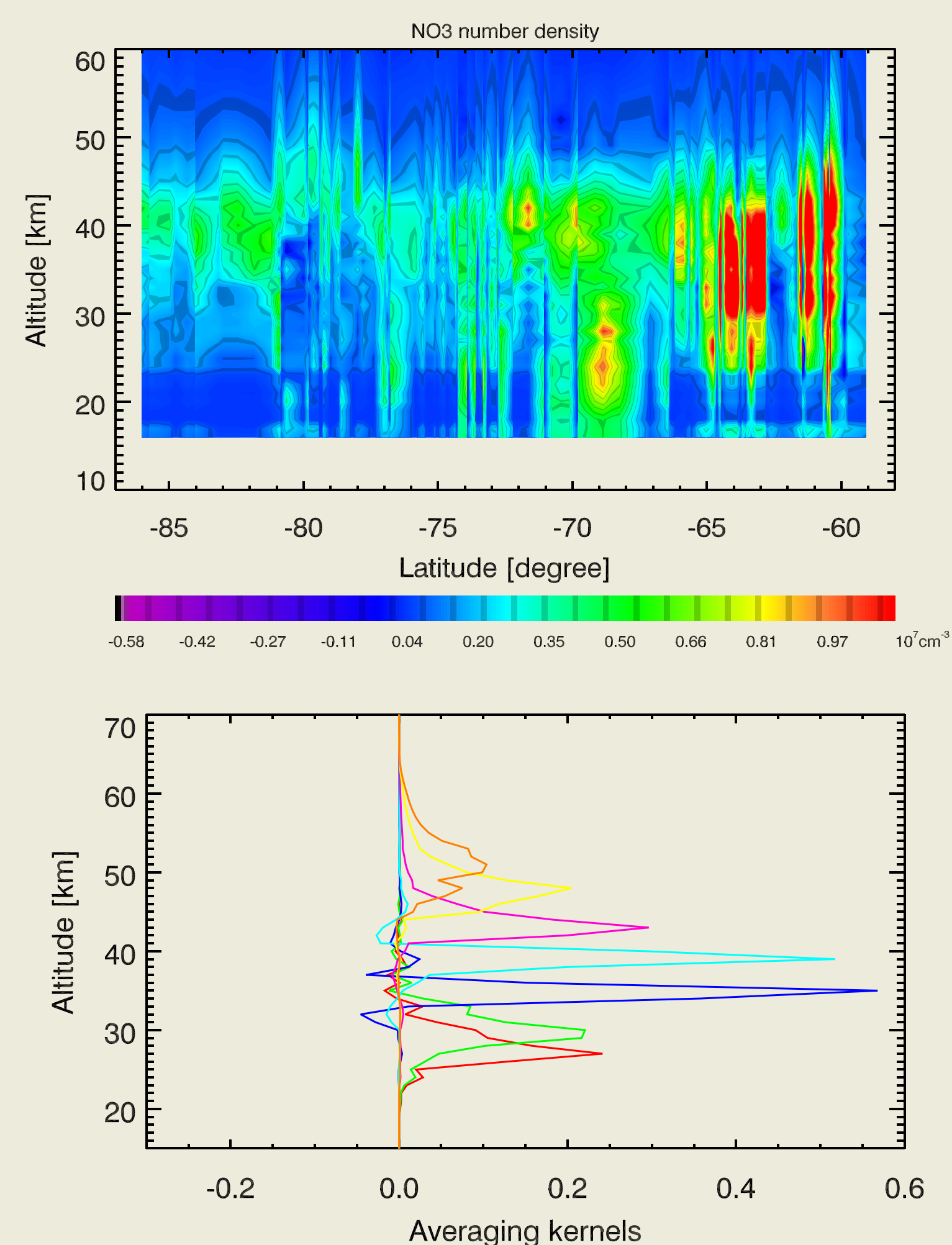
Our current understanding of NO₃ chemistry and internal consistency of the retrieval results were verified with a relatively simple model scheme. The model scheme used ozone profiles retrieved from SCIAMACHY lunar occultation measurement [1] and ECMWF temperature as input.

Below approximately 40 km, the observed NO₃ is well reproduced with correlation coefficient in the range of 0.8 - 0.9. The difference between the observed and model calculated NO₃ profiles are within the estimated accuracy of 20 - 35%, demonstrating that we have reasonable understanding of polar stratospheric NO₃ chemistry [2].

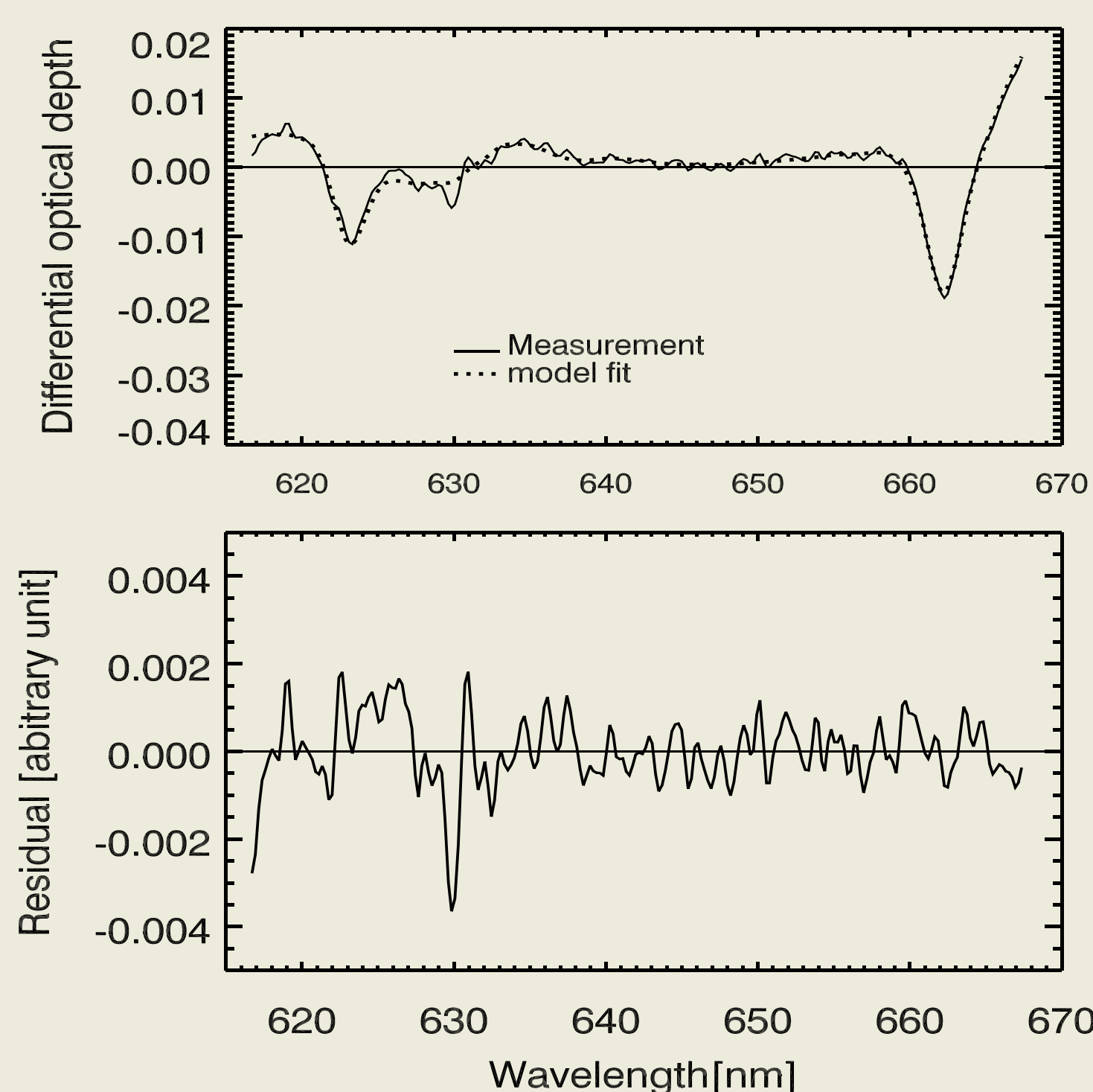
Retrieval results

In this section, the zonal mean of 131 number density profiles of retrieved NO₃ from March to June 2003 covering latitude range of 60°S - 85°S is presented (top-right panel). Highest concentrations are found in moderately high latitudes (60°S - 65°S). These values are due to warmer stratospheric temperatures in March.

In the lower panel of this section is the example of the averaging kernel for March 12, 2003, orbit number 5390 and solar zenith angle 105.8°. This result is based on 1 km vertical resolution.

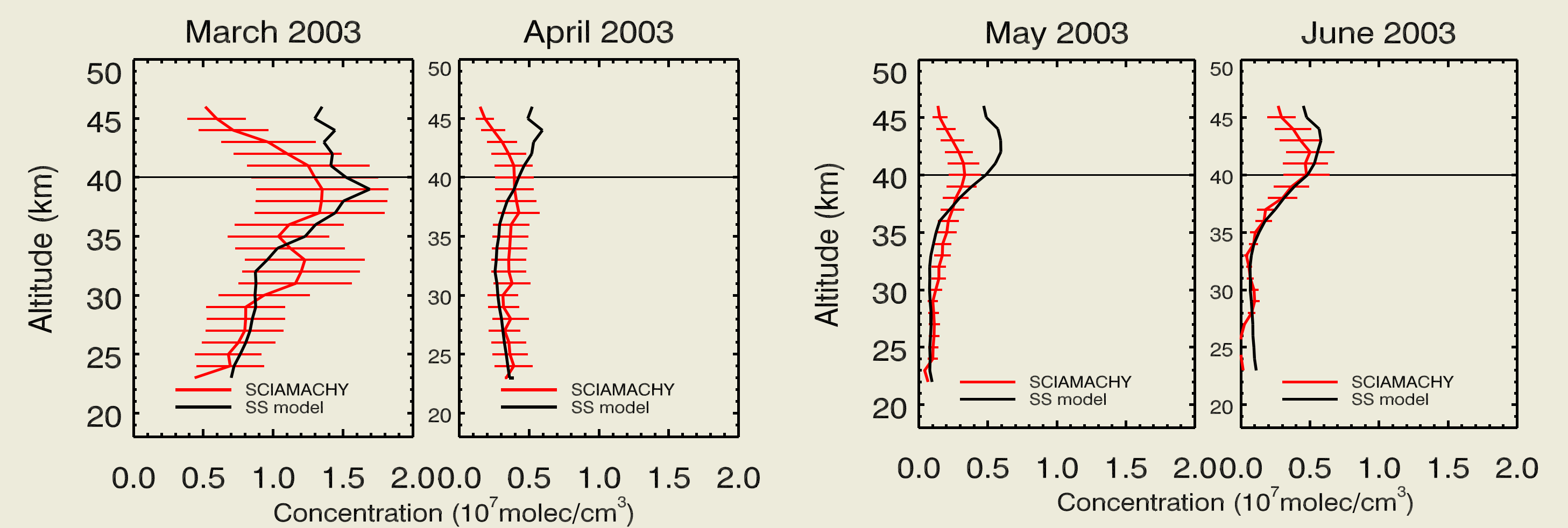


NO₃ Spectral fit



The spectral fit and residual are shown in this section. The fit at 39 km tangent height for March 12, 2003 orbit 5390 (top-left). The dotted line represents the modeled differential optical depth of NO₃ and the solid line the measured differential absorption spectrum of NO₃. At the bottom-left of this section is the spectral residual of the fitted gases. Good fit to NO₃ absorption is observed and spectral residual is in the order of 0.2% for all relevant height layers.

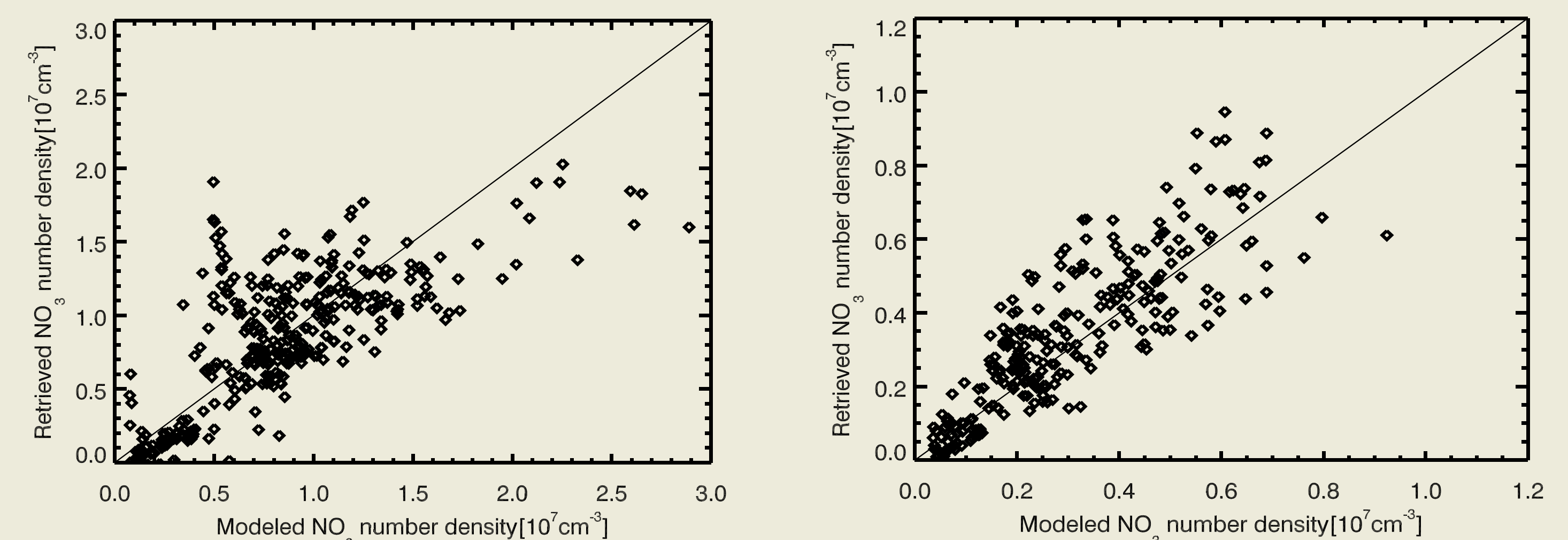
Comparison with model calculation



1-D photochemical model has been used to calculate the NO₃ number densities and the result have been compared with retrieved profiles [2]. The model scheme used in the study presented here is a very simple scheme that assumed that at steady state the concentration of NO₃ depends on the concentration of ozone and temperature. Hence this model scheme is named steady state model (SS model).

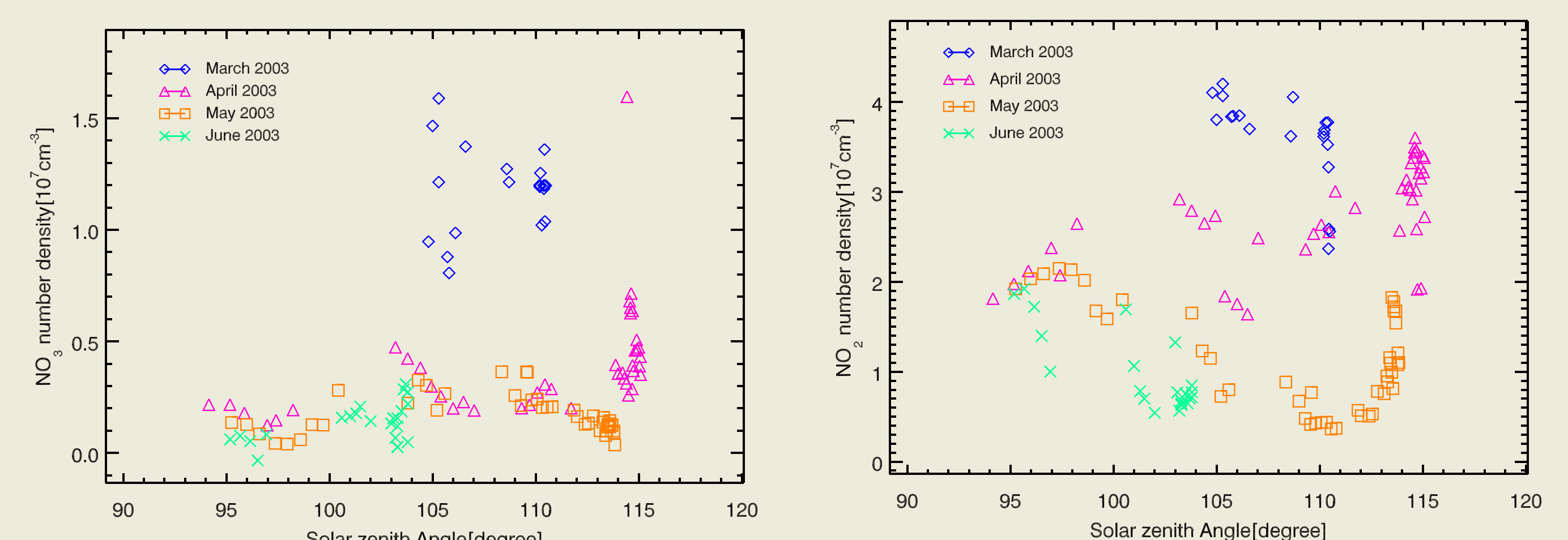
The top panel of this section is the result of the monthly mean of NO₃ profiles retrieved from SCIAMACHY lunar occultation spectra compared with NO₃ profiles calculated from SS model. Red solid lines are the retrieved results and the black lines are the model output. The error bars represents the maximum estimated retrieval error of 35%.

In the bottom panel of this section, the results of a plot of retrieved NO₃ as a function of model NO₃ are displayed. Left the result of latitude band of 60°S - 65°S and right the result of latitude band of 66°S - 72°S. Good agreement is observed between retrieved and modeled NO₃ with high positive correlation of 0.83 - 0.98.



Conclusion and outlook

- ✓ The first NO₃ measurement over high latitudes in the southern hemisphere have been presented.
- ✓ Understanding of NO₃ chemistry at the location of measurements have been tested with model.
- ✓ Good agreement of retrieved NO₃ with model demonstrating that we have reasonable understanding of NO₃ chemistry in the polar stratosphere.
- ✓ We observed that retrieved NO₂ and NO₃ show strong diurnal variation. A graph showing the diurnal variation is shown below. Studies into the diurnal variation will be carried out in the future



Acknowledgment

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References

- [1] Amekudzi, L.K., A. Bracher, J. Meyer, A. Rozanov, H. Bovensmann, and J.P. Burrows (2005a), Lunar occultation with SCIAMACHY: first retrieval results, *Advances in Space Research*, 35, doi:10.1016/j.asr.2005.03.017.
- [2] Amekudzi, L.K. B.-M. Sinnhuber, N.V. Sheode, J. Meyer, A. Rozanov, L.N. Lamsal, H. Bovensmann, and J.P. Burrows (2005b), Retrieval of stratospheric NO₃ vertical profiles from SCIAMACHY lunar occultation measurement over the antarctic, *J. Geophys. Res.*, 110, D20304, doi:2004JD005748.